THE GREAT BARRIER REEF OF AUSTRALIA

A POPULAR ACCOUNT OF ITS GENERAL NATURE, REVISED BY THE GREAT BARRIER REEF COMMITTEE, BRISBANE, 1929.

Issued by
The Queensland Government
Tourist Bureau,
Railway Commissioner's Office,
George Street, Brisbane.

The Great Barrier Reef of Australia

A Popular Account of its General Nature, revised by the Great Barrier Reef Committee, Brisbane, 1929

The Great Barrier Reef Committee is composed of representatives of the various scientific institutions throughout Australia and New Zealand, and has been formed with the object of investigating the problems—both purely scientific and economic—of one of the most unique physical features possessed by Australia

Third Edition, 1929.

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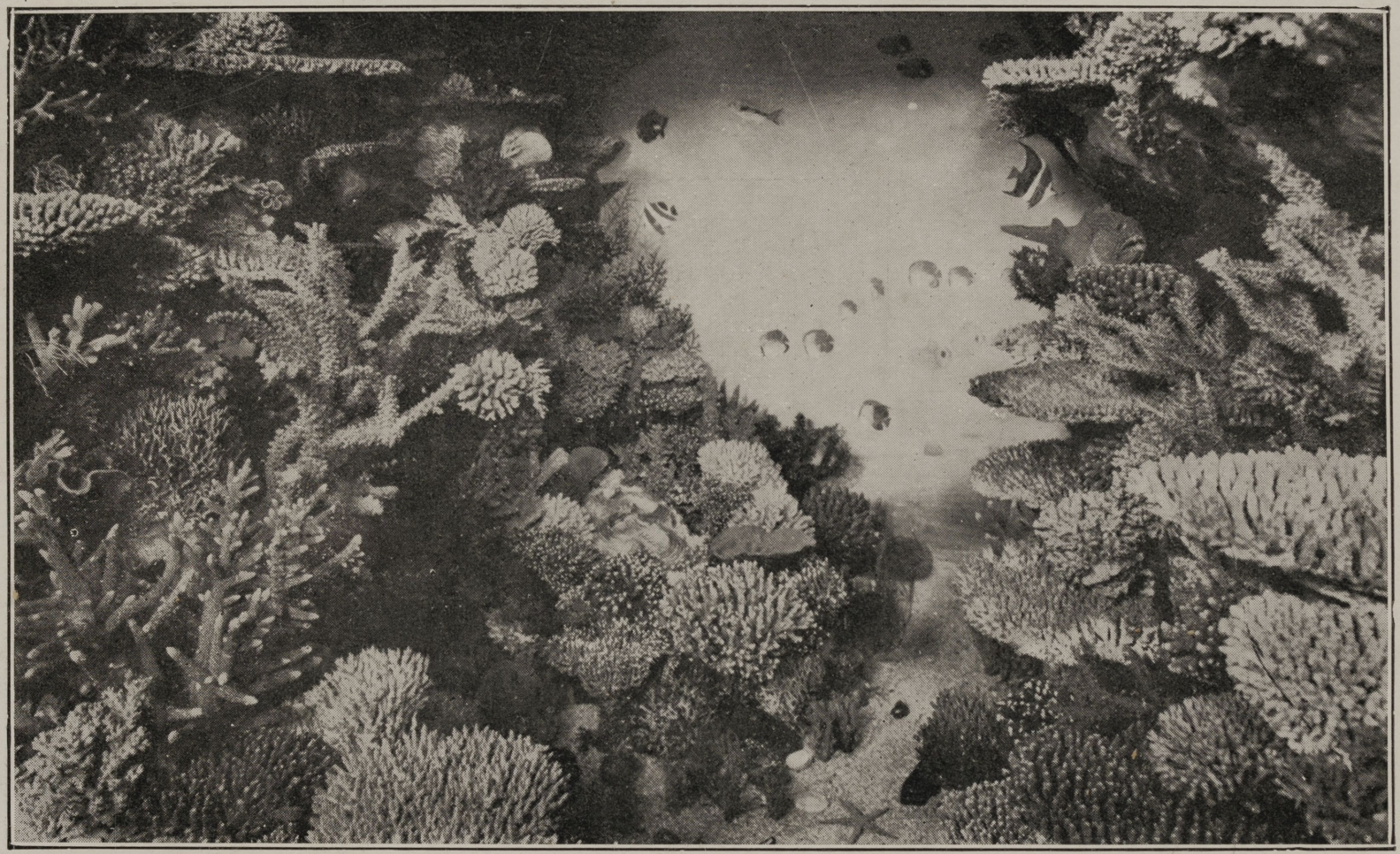

Coral Pool, Queensland Museum, displaying 24 Varieties of Coral gathered from Great Barrier Reef, N.Q.

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FOREWORD.—The first edition of this booklet was written mainly by the late Charles Hedley, F.L.S., at that time the Scientific Director of the Great Barrier Reef Committee's investigations, and this third edition is essentially his work, apart from the Botanical Section which was compiled by Mr. C. T. White, Government Botanist. Mr. Charles Hedley was an enthusiastic and understanding investigator of the Great Barrier Reef, and it is of pathetic interest that, in accordance with his last wishes, his ashes were consigned to the waters of the Reef which in his lifetime he loved so well.

This third edition contains also a short account by Dr. C. M. Yonge, D.Sc., Ph.D., Leader of the work of the Expedition at Low Island, and other matter has been added to bring information up to date.

INTRODUCTORY.

IN the ports of Europe old sailors spin their yarns, telling tales of the wide, wide world, tales of the Southern Seas. They tell how once they sailed into the calm lagoon, beached their boat upon the yellow sand, and walked beneath the cocoanut palms to the native village. From the brown thatched houses came brown men and women—stalwart men, handsome women—who gave to their visitors strange and delicious fruits, and who decked them with sweet garlands of flowers.

But behind the brightness of this picture was a gloomy shadow—the shadow of the coral. For the ancient mariners

never thought of coral as a thing of beauty or romance. To them it was a horror, worse dreaded than the ice-flow or the fog or any terror of their Northern Seas. To them the coral represented a demon against whom neither skill, care, nor knowledge availed; by whom at any instant in storm or fine, day or night, their ship might be wrecked and themselves slaughtered. This demon of the coral had for his fellows two evil spirits blacker than himself—the demon of the hurricane and the demon of the man-eater. The Arctic gales which whip the North Sea in winter are gentle breezes in comparison with the hurricanes of the Tropics, which toss a ship ashore like a cork or sink her like lead in mid-

STAG'S HORN REEF, OUTER BARRIER.
[*W. Saville-Kent, Photo.*]

ocean. Sad was the fate of the sailors who were battered to death on the jagged coral or smothered in the foam; but more dreadful by far was the death of those who struggled

ashore alive only to fall into the hands of cannibals—to be fattened, slaughtered, and eaten like sheep or fowls. Mostly these unlucky adventurers just vanished and their sufferings were unknown. Sometimes the news of their disaster reached home after long years, as in the case of La Perouse, whose crews perished in Vanikoro when his two great warships were flung by the hurricane on the coral reef.

HISTORICAL.

When the British captured the city of Manila in 1762, the opportunity was taken to search the old Spanish archives. One of the most interesting documents found there reported a great geographical discovery, the first passage of Torres Strait, kept a secret by the Spaniards for a century and a-half.

Torres.

In the year 1605, an expedition had started from South America to explore the South Pacific Ocean. Three vessels under Admiral de Quiros sailed westwards from Callao. After the discovery of the New Hebrides and Solomon Islands, Captain Luis Vaes de Torres separated from his companions and coasted along the Louisiades and the south coast of New Guinea. Following the land south-westwards he reported passing some very large islands about the eleventh degree of south latitude, after which he entered the Arafura Sea. Since Cape York is in south latitude 10° 41′, the hills of Cape York and Prince of Wales Island must represent those large islands. The honour withheld from the explorer by his own countrymen was restored by the British cartographers, who bestowed the name of Torres Strait on the passage between Papua and the Spaniards' "Tierra Austral."

Captain Cook.

The next European to visit this region was that prince of navigators, Captain James Cook. East Australia was then a blank on the map. On this blank, Cook drew 2,000 miles of coast before he joined up with the survey of Torres. June, 1770, found him cautiously moving northwards, sounding and charting as he went, quite unconscious of the existence of the Great Barrier Reef that was closing in upon his track. Low Islands, where a lighthouse now stands, was

CHARTERED REEF, THURSDAY ISLAND, TORRES STRAIT.
[*W. Saville-Kent, Photo.*]

his first coral island, but he could not recognise it as such or profit by the warning it conveyed. In the night of 11th June, the ship struck hard and fast on a coral reef, now called the Endeavour Reef, between Port Douglas and Cooktown. The accident was a terrible one, because the ship was threatened with destruction, and any helpless

survivors would have been butchered by the mainland natives. The hull was pierced by the coral and leaked badly. As much as possible, including all the guns, was thrown overboard to lighten the ship. Fortunately, the sea remained calm and the weather fine. After twenty-four hours the ship was hauled off the rocks and was "fothered," by drawing a sail underneath her keel until the leak was covered. The crippled barque was sailed across to where Cooktown now stands, emptied, laid on the beach, and repaired.

Cook ascended Grassy Hill, and to his horror saw, spread like a map beneath him, a maze of reefs in every

SECTION OF GIBSON REEF WHEN THE RISING TIDE BEGINS TO COVER THE CORAL.

[*Chas. Hedley, Photo.*]

direction. When the ship was again seaworthy, Cook made all haste to reach the deep water off shore. With anxiety and care he crept out between the reefs until, from the high peak of Lizard Island, he could see a clear opening through the Outer Barrier. Cook's relief at gaining freedom

from the reefs was short-lived. Three days afterwards the ship was becalmed off the Outer Barrier. The waves carried the vessel nearer and nearer to the reef till "the ship rose on a breaker prodidgiously high so that between us and destruction was only a dismal Valley, the breadth of one wave. All the dangers we had escaped," wrote Cook, "were little in comparison of being thrown upon this reef, where the Ship must be dashed to pieces in a Moment." At the last dreadful instant, "a Small Air of Wind sprung up" and pulled the ship out of the jaws of death. An opening —Cook's Providential Channel—was then reached. Glad though Cook had been to leave the Barrier, his joy at finding himself safe inside it again was far greater.

Another week was spent, with boats constantly ahead to signal shallow water, before he reached Torres Strait. On 22nd August, 1770, Cook landed on Possession Island, and in the name of His Majesty King George the Third took formal possession of the east coast of New Holland.

William Bligh.

It was a pupil of Captain Cook, their commander William Bligh, whom the mutineers of the "Bounty" thrust overboard into an open boat, only twenty-three feet long, with eighteen companions and a scanty supply of provisions. On 29th May, 1789, a month after he had been turned adrift near Tahiti, Bligh heard at midnight the roar of the surf on the Great Barrier. Next morning he found a passage through the reef a few miles south of the opening which had proved Cook's salvation. Crossing the lagoon channel, Bligh landed on an island which he called "Restoration Island," for the double reason that he arrived there on the anniversary of the Restoration of Charles II. and that it restored him and his crew to health.

A high hill with forest to the water's edge, and a

beautiful sheltered sandy beach, welcomed the voyagers. In this delightful resort, fresh water, wild fruits, and oysters were procured. A fire was made with a magnifying-glass. But, after enjoying two days' refreshment ashore, Bligh was alarmed by a horde of savages gathering on the mainland opposite. Continuing his voyage, Bligh put in first at Sunday Island and then at Turtle Island, where fresh provisions were gathered in the way of clams, oysters, sea-birds, beans, and berries. A week was thus spent, cruising along the coast of Queensland, after which was made the passage of Torres Strait. He reached Timor on the 14th June, with his crew in the last stages of exhaustion from starvation.

MASTHEAD ISLAND, CAPRICORN GROUP.
(Showing coral island in lagoon from reef.)
[*A. R. McCulloch, Photo.*]

Matthew Flinders.

Under more prosperous circumstances, Bligh came to Torres Strait again. In 1792 he spent three weeks in command of two ships of the Royal Navy, and explored the

whole area, mapping it for the first time. He described the islanders with admiration as "dextrous sailors and formidable warriours." Bligh had with him as his junior officer an explorer who became even more famous than himself—Matthew Flinders—who was destined to increase greatly the knowledge of the Great Barrier Reef.

Probably no other space of the same size was crowded with so many dangers to the mariner as the 200 miles that lay between the Pacific and Indian Oceans and between

INSHORE REEF, PALM ISLANDS, NORTH QUEENSLAND.
[*W. Saville-Kent, Photo.*]

Australia and New Guinea. In the short interval between the first and second visits of Bligh, a British man-of-war had been wrecked there. On 25th August, 1791, Captain Edwards, in H.M.S. "Pandora," bound westward, met the Great Barrier Reef in the latitude of Cape York. Following the reef he discovered three high volcanic islands which he

named the Murray Islands. The accident from which Cook had escaped so narrowly then befell Edwards. At a critical moment the wind dropped and the current drove the man-of-war on to and over the reef. Next morning she sank in fifteen fathoms, with a loss of thirty-nine men. The survivors, almost destitute of provisions and water, sailed in four boats through a new passage in Torres Strait. After suffering great hardships, they arrived at Timor on 14th September.

To-day the dread of the coral reef has abated. The mazes of the reef have been sounded, measured, and mapped. Safe routes are found and beaconed by which vessels may traverse the danger zone in safety.

UNIQUE GEOGRAPHICAL FEATURE.

The continent of Australia, while unable to match the large rivers or high mountains of other lands, possesses one geographical feature in which it is supreme, and that is the possession of the largest coral reef in the world. This reef extends along the coast of Queensland for more than a thousand miles. The next largest reef is that which frames the island of New Caledonia. Neither of these has received as much attention from investigators as its importance deserves.

BUILDING OF THE CORAL REEFS.

The builder of these huge structures is, to express it simply, a little lump of animated jelly, often termed the "coral insect," but more properly called a polyp. This varies from the size of a hand to that of a pin-head, and is almost exactly like a sea anemone. Corresponding to the petals of a flower are a circle of waving arms and in their centre the stomach. As animalculæ float past and touch the polyp they are secured with tiny poison darts. When a hit is scored

the victim is stung to death, and in falling is caught by the waving arms and pushed into the centre of the disk, where the stomach opens to swallow the prey whole. The lime found in the food is deposited around the polyp, just as the human body uses lime to make its bones, and thus the coral rock is formed. A branch of dry coral appears as a delicate fabric of white stone pitted over with cells; on magnification

NIGGER-HEADS ON ST. CRISPIN REEF, OUTER BARRIER, OFF PORT DOUGLAS.

[*A. R. McCulloch, Photo.*]

each cell is seen to have a series of radial partitions. When the coral was alive a polyp sat in each of these cells, and the partitions are imprints made by its soft body. When alive a thin membrane extended from one cell to the next, so

that each individual, though capable of a separate life, was one flesh with the whole colony. When alive the coral would be coloured, frequently brown, but sometimes with vivid hues of red, yellow, green, or blue.

Two conditions are particularly required for the existence of reef-building corals. In the first place the seawater must be pure; especially must it be free from mud; and in the second place it must be very warm. Though corals predominate in the upbuilding of a coral reef, a large share in the work is contributed by other things, such as shells, foraminifera, and seaweeds.

THE FOUNDATION OF THE REEF.

Nowhere does dry land face deep sea; between them intervenes a bank stretching seawards for 10 to 100 miles, and sloping outwards from a depth of 10 fathoms to 100. This shallow fringe, which is called the "continental shelf," makes a step between the land and the abyss. From its outside edge the seafloor plunges down steeply, and here the ocean depths commence.

The continental shelf of Eastern Australia is narrower in the temperate than in the tropical zone, where it makes a foundation for the Great Barrier Reef. As the water becomes gradually warmer reef-building corals appear. Even as far south as Sydney small stray corals are seen, and in Moreton Bay, off Dunwich, near Peel Island, in latitude 27° 30′ S., several species occur. The southernmost place where the corals have built reef is at Lady Elliot's Island in south latitude 24° 7′, a broad platform of solid coral half a mile in circumference, on which a lighthouse stands. A few miles further on the coral islets assemble in an archipelago—the Bunker Group—which passes into a larger group, called from its latitude the Capricorn Islands. Having entered the Tropics, the reefs multiply fast. The system

of the Outer Barrier commences with the loosely scattered series of the Swain Reefs, about which little is yet known. Proceeding north, the Outer Barrier becomes more compact.

COLONY OF NESTING SEA BIRDS, SOOTY TERNS (*Sterna fuscata*) ON OYSTER CAY—A CORAL REEF NEAR CAIRNS.

[*H. C. Richards, Photo.*]

THE OUTER BARRIER.

From northwards of 18° south latitude there develops a succession of broad linear reefs awash at high tide; each is several miles in length, and perhaps half a mile in breadth, and separated from the one in front and behind by a channel of half a mile or so. Upon their banks a mighty surf beats incessantly, even in the calmest weather. As the long rollers

of the open ocean suddenly encounter the Great Barrier, they rear up into huge waves, topple, roar and crash upon the reef, spending themselves in a long smother of foam across the flat. At high tide, when no obstruction is visible, the sight of the long line of boiling surf, springing up in mid-ocean without any apparent cause, is as strange as it is magnificent.

The space between the Outer Barrier and the mainland varies from 80 to 20 miles in breadth. This is a region of comparative calm, for the outer reef serves as a breakwater to exclude the ocean swell. The phrase "Great Barrier Reef" conveys to many people an idea of a single complete structure arising out of the sea like the Great Wall of China. Perhaps it would be better if we spoke of the "reeferies" rather than of the reef, for the Great Barrier is composed of an infinite maze, and endless complex of individual reefs, different in size, shape, and spacing.

A Raised Beach on North Barnard Island.
Showing geologically recent upheaval movement of the Coast.
[*Chas. Hedley, Photo.*]

AUSTRALIA'S GRAND CANAL.

The area between the Outer Barrier and the mainland is divisible into two regions—an inner narrow zone along the land comparatively free from coral, and an outer belt overgrown with innumerable reefs. This inner zone includes the coastal highway along which pass the interstate and foreign shipping, always within sight of the mainland. Here the water is muddy from the discharge of rivers, and the depth varies from 5 to 20 fathoms. The outer offshore zone carries a depth of from 20 to 70 fathoms; the water is clear and blue. Being thickly strewn with reefs, many of

GROWING CORAL IN SHELTERED LAGOON ON YOUNG REEF (Lat. 12° 7′ S.). (Upward limit of coral growth shown; also effect of sediment.)

[*H. C. Richards, Photo.*]

which are still uncharted, it is most dangerous to navigation. No one ventures into these intricate passages, except the hardy fishermen who sail there to gather pearl-shell, trochus, or bêche-de-mer.

MOUNTAINOUS ISLANDS.

Between the inner and the outer zones stretches a string of lofty islands extending for several hundred miles from the Keppel Islands in the south to Lizard Island in the north. Rarely does a traveller lose sight of one of these high islands before another rises into view. There are places where, as in the Whitsunday Passage, vessels wind through fiord-like channels with a chain of mountain islands on either hand. Many of these islands are well wooded and watered by fine streams; they may be two or three miles in length and rise to a height of several hundred feet. Their beautiful bays and beaches beckon invitations to the wanderer, and an examination of the cliffs in many cases shows clearly the evidence of uplifting movements of the islands as wave-cut benches now occur above high-water level.

The plants and animals of these high islands are closely related to, and usually identical with, those of the nearest mainland from which obviously they have been derived. When the sea overflowed a former coast, drowning the plains and valleys, it left peaks and ridges to project above the water in the form of existing islands. Reconstructing the lost land, the former shore line of Queensland is indicated as buried below the Outer Barrier Reef and the former coast range is represented by the present high islands. These islands are composed of granitic or some other old rock of continental origin.

CORAL ISLANDS—ATOLLS AND CAYS.

In sharp contrast to the mountainous islands of the inner zone are the low islands outside them; the distinction between the two is one of kind, not of degree. The high islands are sunken granite peaks, the low are banks built up of coral. As far as the eye can reach, the features of either

are recognised immediately. Descriptive names applied to such islands are "Low Island" or "Low Woody Island."

These low coral islands are termed "atolls" when they form a ring, more or less complete, of dry land enclosing a lagoon; and are termed "cays" when they are solid islands

GROWING CORAL SHOWING UPPER LIMIT OF GROWTH AND EFFECT OF SEDIMENT, YOUNG REEF (Lat. 12° 7′ S.).
[*H. C. Richards, Photo.*]

without lagoons. The land is sometimes a bare sandheap; at a further stage of development the island may have a beach of coral rock, and may be covered more or less densely by low trees and shrubs. Seen on the horizon such an island forms a narrow, horizontal black bar; a little nearer it is like a raft overgrown with bushes. As the tide falls the reef is exposed in a great plain of sand, mud, and broken coral, which extends in some cases for miles, and viewed from the beach it stretches to the horizon. The higher points, which become islets at high water, are arranged irregularly along its margin, from which the slope plunges down rapidly to depths of 5 or 8 fathoms.

The formation of these coral islands has given rise to long controversy and to various and complicated explanations. In some cases a granite island continued to sink till it was completely drowned, and upon that base coral has

CORAL ROCK BEING DISSOLVED AND DISRUPTED BY THE WAVES ON WINDWARD SIDE OF COQUET ISLAND (Lat. 14° 32′ S.).

[*H. C. Richards, Photo.*]

grown. One writer imagined that the atoll islands began as a solid block, and that the sea dissolved away the interior, thus converting it into an atoll.

A recent theory holds that these more or less imperfect atolls have grown up from the even floor of the lagoon channel, and that they are moulded to their present form by the prevailing south-east winds, being in fact stream-lined. At first a spire of coral may have ascended to the surface. Round some such obstacle drifting masses of broken coral, shells, and sand were packed up by the wind and waves. The islet thus formed has a crescentic shape, its back to the wind, and horns directed to leeward. Every storm enlarged

the original crescent by piling up further débris on the windward side, until eventually a horse-shoe form was developed. By a continuation of the same process the ends of the horse-shoe approached each other and finally united. Where the winds are normal and variable, playing first from one quarter and then from another, an atoll can never be formed. According to this explanation, the lagoon represents a space of the original foundation which is left uncovered by coral. But the existence of the lagoon is a temporary feature; the forces that built the atoll will in the course of time eventually fill up the lagoon and convert the atoll to a solid cay, over which a forest will spread at last.

LIFE IN THE CORAL.

That portion of the beach of a coral island which is exposed by ordinary tides is paved with a litter of dead and broken fragments of coral. These are strewn in confusion, and often become consolidated into rock. The living reef whose wastage builds the dry land is only uncovered by an extremely low tide. It is best viewed through a water telescope when drifting in a boat, and it presents a beautiful spectacle comparable to an exquisite garden. In colour, brown predominates, but there are brilliant touches of orange, blue, red, and green. The submarine landscape is diversified by various shapes—huge hemispheres, flat tables, many-pointed antlers, shrubs, fans, and vases. Through these coral groves swim fish of quaint form and as brightly coloured as butterflies. Here and there perch sea-urchins with long spines like knitting-needles or short ones like pencils. Starfish, some blue as the sky; bêche-de-mer, some black as ink, are scattered about; great clams with jaws a yard across gape for the unwary. As the boats drift by, the visitor is fascinated by the wonderful shapes and colours reeled off beneath him. So vast is their population that no

naturalist in the world can catalogue the furniture, or appraise the wonder, of a coral reef alive and in full bloom.

ECONOMIC WEALTH.

But the Barrier Reef has other attractions; it is the scene of several important industries which may under good management attain to larger dimensions.

QUEENSLAND PEARLS AND PEARL SHELL.

Fish.

Food fishes abound in great variety and large numbers, and no doubt in the future a great trade in these will be developed.

Pearl-shell.

For many years the most lucrative business has been that of pearling. The pioneers found great pearl-shells growing on the beaches at low water; but such shell as could be reached by wading was soon exhausted. Natives of Torres Strait were then engaged to gather by diving for the shell which grew in shallow water. As the more accessible fields became exhausted, shell was followed into deep and

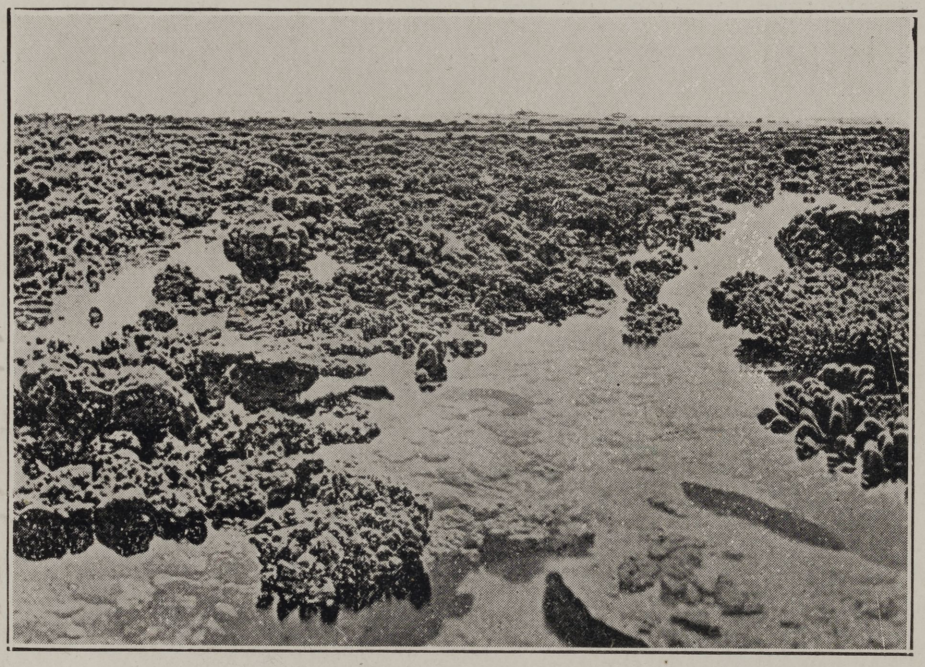
BLACK LIP PEARL-SHELL.

then deeper water. Finally, the divers adopted the helmet diving dress and air-pump. Thus equipped, the modern pearl-sheller descends from a lugger and walks about on the sea-floor, picking up what shells he finds and giving directions to his crew with a signal cord held in his hand. The shells are the property of the owner, but the pearls themselves are the perquisite of the divers. From time to time the beds become exhausted by over-fishing, and the pearling fleet give them time to recover by moving to another district. Small and handy luggers are usually employed in this trade, and the majority of the crew are Japanese. For the year

1927-28 the export of pearl-shell from Queensland was valued at £167,487.

Bêche-de-mer.

Second in importance is the trepang or bêche-de-mer industry. This creature is a sea-slug, shaped like a cucumber,

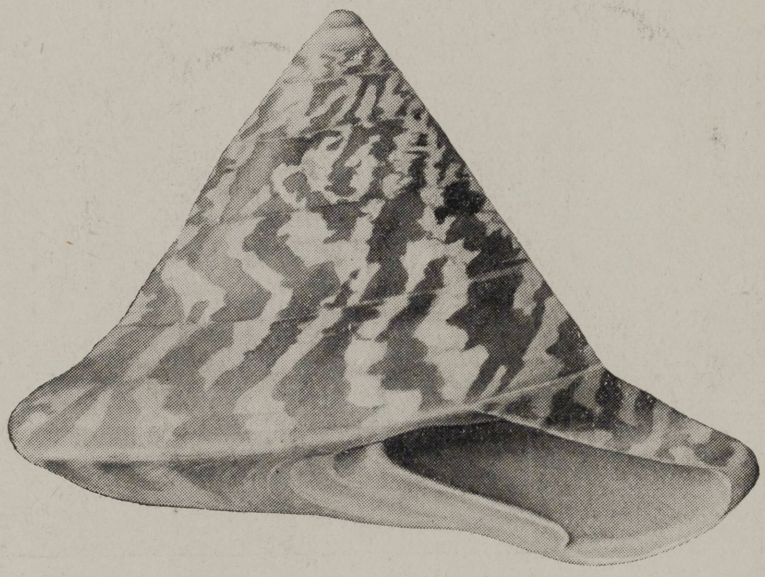


OUTER BARRIER REEF WITH SUBMERGED BECHE-DE-MER.
[*W. Saville-Kent, Photo.*]

about a foot long and two inches broad. It crawls about in the pools of the reef and is gathered by hand, but in deeper water diving is necessary. There are a dozen or more different kinds varied in shape and colour; some of these are of no commercial value, but the higher grades are worth three or four times as much as others. The bêche-de-mer are prepared for market by being boiled, gutted, and dried. At this stage the product appears like scraps of old leather. It is bagged up and sent to China, where it is esteemed as a basis of soup. In 1927-28 the export was valued at £13,908.

Trochus Shell.

A minor industry of recent development is the gathering of trochus shell. This is a pyramidal sea-snail, of three to four inches in diameter, striped with white and crimson bands and richly nacreous within. The shells are gathered by hand upon the coral reef; the contents are removed by boiling and picking or by rotting out in the sand. They are bagged and exported to Japan, where they are cut by



TROCHUS SHELL.

machinery into pearl-shell shirt-buttons. In the year 1927-28 the export of Trochus Shell from Queensland was valued at £61,363.*

Sponges.

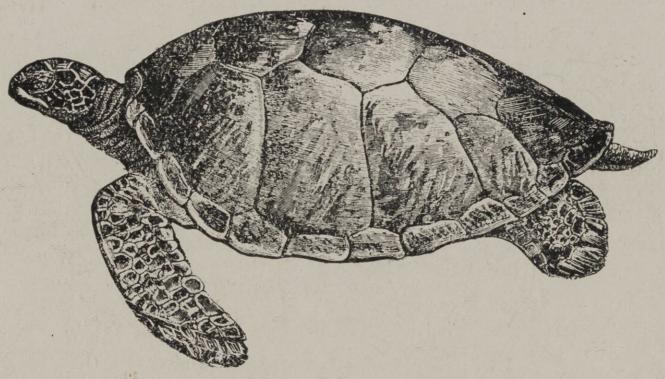
The only commercial sponge yet found on the Barrier Reef is large and coarse, unfit for use as a bath sponge, but serviceable for such rough work as cleaning cars and machinery. It grows in large black masses on the reef-flats,

* Mr. J. D. W. Dick, Chief Inspector of Fisheries, Queensland, has kindly supplied the above statistical information on marine products.

and when cut open looks like a slice of bullock's liver. Perhaps a higher grade of sponge may be found or introduced and cultivated in the future; the conditions under which high-class sponges are produced in Florida seem to be repeated in Queensland.

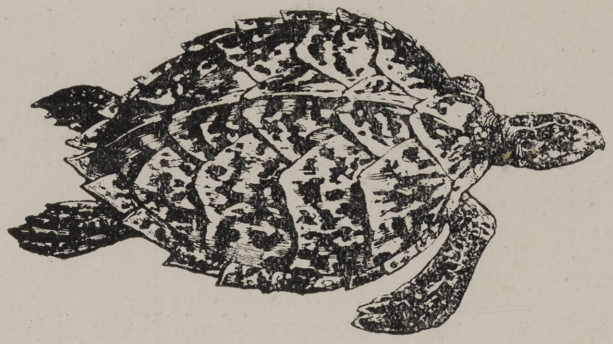
Tortoise Shell.

Both the green and the hawk's-bill or "tortoise-shell" turtle are plentiful, though neither yet ranks as a commercial product. About November the female comes to the sandy beaches of the coral islands, and digs a hole with her flippers in the dry sand above high-water mark. Here a number of eggs are buried and left to be hatched by the heat of the sun without further maternal care, and the young, under cover of darkness, escape to the sea. The egg is about the



GREEN TURTLE.

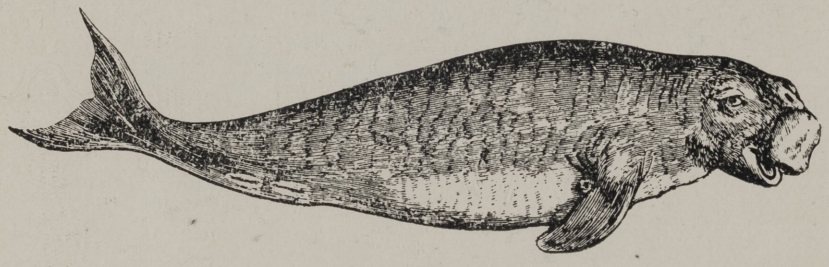
size and shape of a small billiard-ball, and though good for making cakes and puddings, has the peculiarity that it can never be boiled hard. The green turtle itself supplies the favourite dish of aldermanic banquets. From the carapace of the hawk's-bill is obtained the tortoise-shell of commerce. There are several other large turtles living in these waters, none of which is of economic importance. For the year 1927-28, the quantity of tortoise shell obtained in Queensland was of the value of £806.



HAWK BILL TURTLE.

Dugong.

The natives obtain a large supply of meat from turtles and from the dugong. This latter is a marine mammal with ivory tusks, and as large as a cow; it browses on the sea-grass. The flesh has been compared to pork, and dugong oil has been recommended for lung complaints. The dugong is too rare to provide meat for the butchering trade.



THE DUGONG.

A LONELY REGION.

The mainland beaches that face the Barrier Reef are at present vacant, but will probably be utilised for cocoanut plantations in the future. The northern end of the Great Barrier faces one of the most lonely coasts in Australia or in the world. Pioneering is not yet finished here. There are no settlements along the Cape York Peninsula for the hundreds of miles that intervene between Cooktown and Thursday Island. Some day the fine scenery and healthy

climate will attract visitors from the South. No more delightful place for a yachting cruise could be imagined.

THE LATE CHARLES HEDLEY STANDING BY A NIGGER-HEAD ON PIPON ISLAND (Lat. 14° 8′ S.).

[*H. C. Richards, Photo.*]

FIELD FOR INVESTIGATION.

As a field for investigation this area affords rare opportunities. The marine fauna, though one of the richest in the world, has been but little studied. The great question of how the coral reefs are formed is still to be decided. Half a century ago research in these regions was dangerous and difficult. An unarmed visitor landing on any beach in North Queensland was likely to be speared. Circumstances have changed since then. Cape York is now as safe as Melbourne. Only the intrinsic difficulties of the problem remain to baffle the investigator. Years of travel would be required to examine the thousand miles of the Outer Barrier, the

thousand miles of the mainland coast, and the myriad reefs and islands strewn between. That the problems involved are of unusual difficulty is shown by the fact that experienced observers enjoying great opportunities have reached widely different conclusions.

Geological.

It is obvious that the structure of the reef depends upon its foundation, and that to study this invisible foundation is like studying the human skeleton within the living body of a man. This branch is in the hands of the geologists.

CORAL DEBRIS PILED UP ON WINDWARD SIDE OF CORAL ISLAND, CHAPMAN ISLAND (Lat. 12° 53′ S.).

[*H. C. Richards, Photo.*]

The foundation of the reef can only be deduced from borings and from physiography of mainland heights and ocean depths. To the best students such difficulties are incentives.

Investigations are being undertaken to determine the relationship of the coralline material to the underlying rocks, and it is a matter of much interest to know whether the base

is a platform more or less level, or else an area with topographic forms which a drowned land area might be expected to exhibit.

Some people advocate a great thickness for the coral growth, others a thin veneer of but a few hundred feet, but apart from the thickness, it is interesting to find out whether the coral mass is made up of coralline material formed where it now rests, or whether it is made up largely of coralline detritus.

The geological age of the coral reef is also interesting, and in carrying out the boring operations through the coral reef, great importance will be attached to ascertaining whether there are any marine sediments of mud, &c., between the coral and the old underlying rocks, and if so, whether these sediments contain any fossils to indicate their geological age.

Much in the way of geological and other nature depends upon the result of the proposed boring through the coral.

Boring at Oyster Cay.

Since the above was written, a bore has been sunk to a depth of 600 feet at Oyster Cay, Michaelmas Reef, 22 miles N.N.E. of Cairns. In order to avoid the probably abnormal conditions at the north and south ends, a position near the middle of the Barrier was desired, and one as far as possible from the main land consistent with accessibility for landing machinery and stores. Owing to the absence of dry land, it was impossible to select a site on the Outer Barrier, which would have been preferred for the investigation. Of available sites, Oyster Cay best fulfilled the requirements.

The result of the boring has been extremely interesting, and is the more valuable scientifically for its having yielded data which were not entirely in accord with expectations

based on any of the previous theories of Barrier Reef formation.

The bore showed only a few feet of solid coral core. Besides this, loose coral and foraminiferal sand entirely of marine origin was passed through to a depth of 477 feet. From this down to 600 feet the material was a fine land-derived quartz sand, with glauconite, shell fragments, and foraminiferal remains.

Throughout the world generally, the submarine margin of the continents, on the edge of the so-called continental shelf, is regarded as being approximately the 100-fathom line, beyond which the sea-floor falls away to oceanic depths.

This crucial depth—the 100-fathom level—was reached by the bore while still in land-derived sediment. The depth to solid rock is, of course, entirely unknown; it may be a few feet further, or it may be thousands. The bore had passed through 120 feet of the sand, and its main object had been achieved by ascertaining in that one place the depth of the coralline material of the reef and the nature of the substratum. Unfortunately, to continue any further meant great expense, a complete string of smaller casing being necessary. This expense was not felt to be justified, unless the Committee were prepared to go on to great depths, which available funds would not have permitted.

Zoological.

Since the Barrier Reef is built by animals, its problems are in the main zoological, and the best instrument for enlightenment would be a marine zoological station in the Tropics. Here trained observers, provided with proper equipment, could examine the coral fauna alive. It is hoped that the establishment of such a station would not only solve questions of abstract scientific interest, but also matters of practical utility, and would increase employment and add to the national wealth.

PINE TREES (*Araucaria Cunninghamii*) GROWING ON GRANITE, MAGNETIC ISLAND, NEAR TOWNSVILLE.

Savages obtain their supplies by hunting wild animals and gathering wild fruits and roots. Civilised man increases his supplies enormously by cultivating the best animals and growing selected fruits and roots. Such cultivation depends on a knowledge of how such plants and animals breed, and how food, temperature, and disease affect them. To-day the harvest of the sea is gathered, naturally and wastefully, as savages would gather it. But a time will come when civilised man will multiply the fruits of the harvest of the sea by cultivation, as he has done those of the land. But first the zoologists must find out by experiment and study how cultivation should proceed.

Oceanographical.

Work included under the heading of Oceanography—that is, study of the tides, currents, depths, and purity of the water—can only be done on board ships that are specially equipped for the purpose. For all this knowledge we have been, and probably shall continue to be, dependent largely on the Royal Navy and the Royal Australian Navy.

BOTANY OF THE CORAL ISLANDS.

The flora of the low coral islands and the strand flora in general is one more or less characteristic of the Western Pacific. The history of the stocking with plants of coral islands situated some distance from any large land mass is always a subject of great fascination. The principal agents are wind, water, and birds. A characteristic feature of many plants of the strand is that their seeds are of a buoyant nature and adapted for dispersal by ocean currents. Thus it is that the Goat's-foot Convolvulus (*Ipomœa pes-caprœ*) is one of the first plants to become established. This plant is widely distributed over the sand-dunes of the tropics, and is so prevalent as to have given the name of "pes-capræ association" to many ocean-beach floras in the tropics. The

popular and specific names are derived from the characteristic shape of the leaves. Other creepers over the sand are *Canavalia obtusifolia, C. sericea,* and *Vigna lutea*—leguminous plants, the leaves of each of which are composed of three rounded leaflets.

Among the first trees to get a footing is the ubiquitous *Casuarina equisetifolia,* mostly represented in Queensland by the variety *incana.* This tree belongs to a genus of about twenty-five species, finding its greatest development in Australia, and is the only species with a wide geographical distribution, being found over most of the tropical coasts of the Old World. The fruit is a cone composed of a number of fused woody bracts, which, when ripe, open by valves at the top and shed the small nutlets or "seeds"; each of these is dark-brown, and has at one end a beautiful transparent wing, which aids in distribution by the wind.

As an instance of birds as agents of distribution may be mentioned *Pisonia Brunoniana,* which is abundant on some of the islands. The fruits of this tree are cylindrical and covered with a sticky, glutinous matter, by means of which they stick tightly to the feathers and legs of birds and are thus widely distributed. So sticky are these fruits that birds, particularly smaller ones, quite commonly become firmly caught in these trees, and die miserably from their feathers becoming clogged up with the viscid fruits.

Pandanus trees are usually associated with the Coast Oak. A striking tree very common on the islands is *Tournefortia argentea,* easily told by the silvery sheen of its leaves. The fruits of this tree have been known to be quite sound after floating for twelve months in salt water, showing their adaptability for distribution by ocean currents.

Other trees characteristic of the strand flora are *Hibiscus tiliaceus* (Cotton-tree), Pongamia (*Pongamia*

glabra), *Barringtonia speciosa, Vitex trifolia,* and its trailing variety (var. *obovata*). *Abutilon* spp. and *Scævola Kœnigii* are common shrubs in this formation. The common sand-binding grass is *Thuarea sarmentosa; Stenotaphrum subulatum* also occurs here and there. Succulents of the strand are *Sesuvium portulacastrum* and a Spurge (*Euphorbia atoto*). The juice of the former is said to be used by the aborigines for healing stings and also cuts and wounds; the use of the Spurges in this way is well known.

The larger of the continental islands which are passed on a steamship journey up the coast possess for the most part the ordinary land flora of the adjacent coast, but an outstanding feature of many of them is the growth of hoop pine (*Araucaria Cunninghamii*) which clothes the islands, growing from the hilltops right down the rocky foreshores, almost touching the sea, as is well shown by the accompanying picture of pine trees growing on Magnetic Island, near Townsville. Botanical travellers who have passed through the Whitsunday Passage say that these islands remind them somewhat of the pine-clad islands off the Alaskan coast.

The Mangrove Flora of the reef contains practically all the Old World mangrove types. The most outstanding trees are the Red Mangrove (*Rhizophora mucronata*), easily told by its lattice-like growths of stilt roots, while the Black Mangrove (*Bruguiera*) possesses roots that travel horizontally just below the surface of the mud, and every here and there develop knob-like growths (pneumatophores), whose function is to allow communication with the atmosphere and the roots in the water-clogged soil; the White Mangrove (*Avicennia*) possesses similar upstanding roots, but these are smaller and much more numerous, and are commonly known as " mangrove pegs " or " cobblers' pegs." This tree is one of the few trees of the mangrove formation

found outside the tropics and sub-tropics, extending, practically speaking, round the whole coast of the continent of Australia.

Other trees of the Mangrove Flora are the small Mangrove (*Ceriops*), Apple Mangrove (*Carapa* or *Xylocarpus*), River Mangrove (*Ægiceras*), and *Lumnitzera* (two species. In a few places in the extreme north the Nipa Palm (*Nipa fruticans*) is abundant. The thistle-like *Acanthus ilicifolius* and the fern *Acrostichum aureum* are also sometimes found.

THE BARRIER REEF EXPEDITION.

By Dr. C. M. Yonge.

As a result of the activities of the Great Barrier Reef Committee, an Expedition, organised by the British Association for the Advancement of Science, and under the leadership of Dr. C. M. Yonge, D.Sc., Ph.D., left England in May, 1928, its purpose being the investigation of the Barrier mainly from the biological standpoint. On arrival, the staff of the Expedition, originally ten in number, was reinforced

Low Island, headquarters of the Great Barrier Reef Expedition; Expedition huts in foreground.

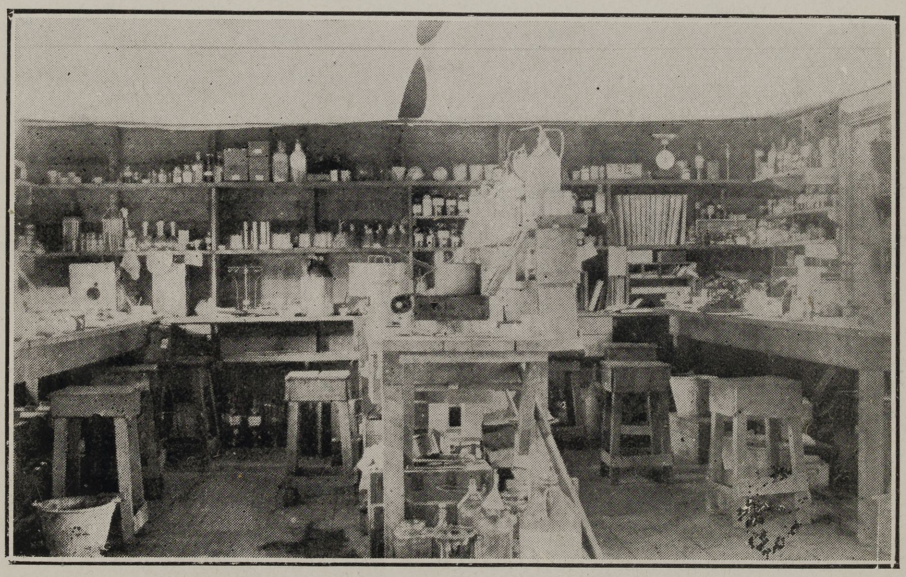
[*Photo.: Mrs. C. M. Yonge.*]

by several Australian members, and proceeded immediately to its base on Low Island, some 45 miles north-east of Cairns, and directly opposite the little town of Port Douglas. Low Island will have been seen by all who have travelled by steamer along the east coast of Queensland on their way to Thursday Island and the Far East, for it lies only one mile inside the steamer channel, and can be distinguished from the many similar islands by the presence of a light-house, a conspicuous white column by day, a friendly flashing light by night. There are really two islands, a sand cay of some three to four acres on which is the lighthouse and on which the Expedition buildings were erected, and a larger mangrove island, which is practically awash at high tide. The two are united at low spring tides, for they arise from a common reef, which then exposes widely between and around them. Seven miles away to the eastward lies the inner side of Batt Reef, a portion of the true Barrier Reef.

The Expedition buildings consisted of wooden huts with galvanised-iron roofs, and included a laboratory and dining-room combined, a kitchen, a bathroom, and two other huts divided into rooms for the single and married members of the staff, and for the accommodation of stores. Mr. A. C. Wishart, of Brisbane, provided his own services and those of his 39-foot motor launch, the "Luana," for the period of the Expedition, and the boat maintained communication with the mainland, and carried the members of the Expedition on trips to the neighbouring reefs, as well as doing weekly "stations" for the collection of water samples and fine "tow-nettings" at various depths.

This boatwork aimed at the discovery of the changes throughout the year in the properties and constituents of the sea-water, and in the nature and numbers of the microscopic animals and plants that drift in countless numbers within it, and four members of the staff were

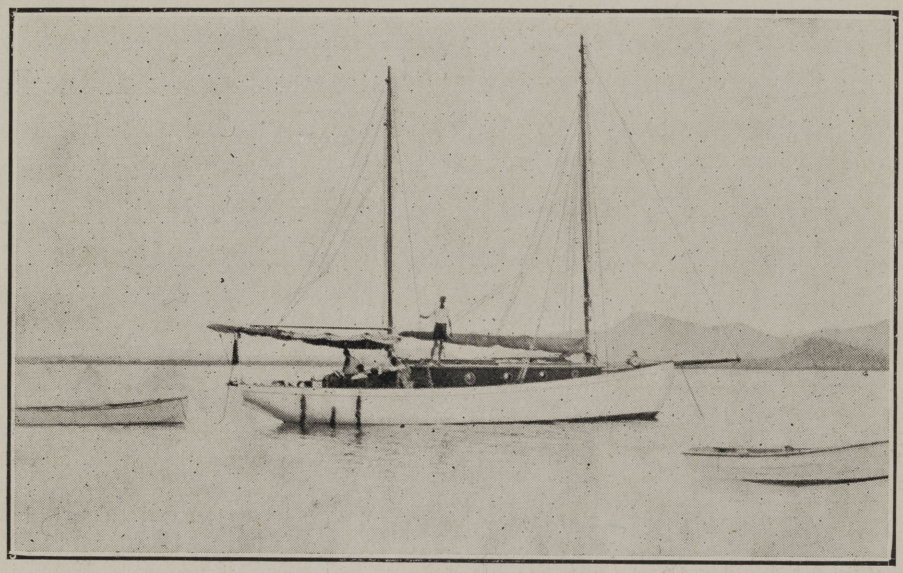
engaged on this work. Corals, naturally, were studied from many different aspects. Collections were made both from the surface of the reefs and, by means of a diving-helmet, from depths of up to 3 fathoms, and detailed studies made of their distribution and numbers in different parts. Their method of reproduction, the development of the minute egg into the full-grown coral with its hard, limy skeleton, the speed of growth of these adult corals, their mode of feeding, their food, and many other details of their lives, all formed a part of the programme of work. Large collections of other animals and of the plants were made, both from the reef and from the sea-bottom around, the latter by means of dredges and trawls.



INTERIOR OF LABORATORY ON LOW ISLAND.
[*Photo.: Mrs. C. M. Yonge.*]

The economic aspect of the reef naturally received much attention. The habits, spawning, and growth of the trochus, the pearl oyster, several kinds of edible oyster, and of the bêche-de-mer all formed subjects of research, most valuable information about the trochus shell, an extremely valuable

commercial product about which practically nothing had previously been known, being obtained. A small commercial sponge of fair quality was found everywhere on the reefs, and experimented on by cutting it into pieces, and trying various methods of growing these pieces, and in many cases

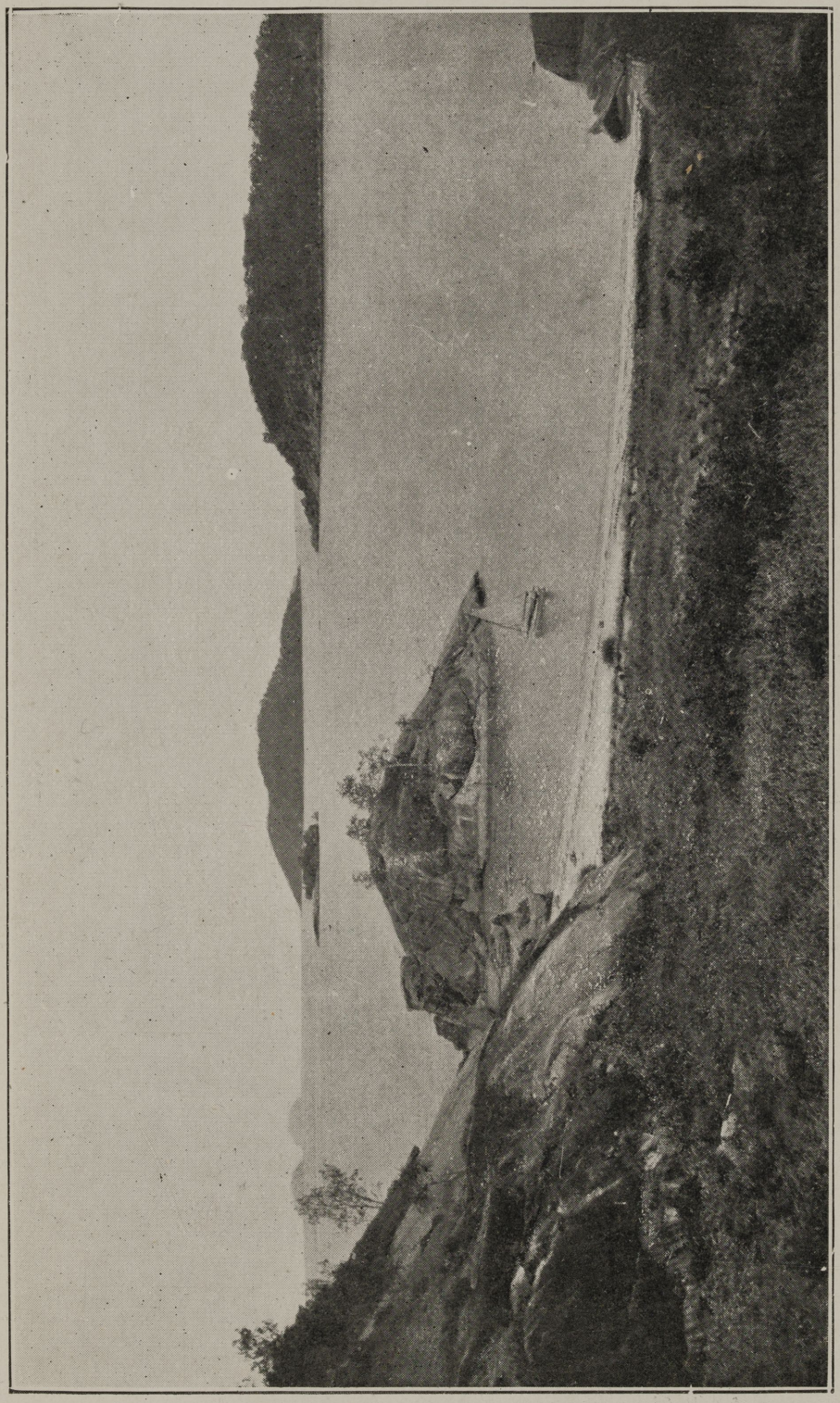


THE M.L. "LUANA," WHEN IN USE BY THE GREAT BARRIER REEF EXPEDITION.

[*Photo.: Mrs. C. M. Yonge.*]

with success, for sponges have the peculiar property of growing well from such "cuttings." The possibility of extending the fishing industry in various regions of the Barrier was studied carefully. Unfortunately, turtles and dugong are rare around Low Island.

A geographical section of the Expedition, under the direction of Mr. J. A. Steers, cruised along the coast from Townsville to the Flinders Islands, examining as many reefs as possible, but paying special attention to the many sand cays, of which Low Island is a typical example, that are dotted everywhere along the coast between the northern section of the Barrier and the mainland. Detailed surveys of Low Island and of a number of other islands were made.



FAMILY GROUP, NORTH ENTRANCE, HINCHINBROOK CHANNEL, N.Q.

The biological side of the Expedition also extended its activities to other regions of the Barrier. Much work was done around Lizard Island, north of Cooktown, both within and without the Barrier; the Torres Strait was visited even to the far outlying Murray Islands; and also Willis Island, the site of the Government Meteorological Station, 240 miles away to the east.

GREAT BARRIER REEF EXPEDITION ON LOW ISLAND (JULY, 1928).
[*Photo.: Mrs. C. M. Yonge.*]

The results of the manifold activities of the Expedition still remain to be published, but when in the near future they appear, they will add a new and most important chapter to the story of coral reef investigation.

30th September, 1929.

A. J. CUMMING, Government Printer, Brisbane.